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THE EFFECT OF THE MATERIAL COMPOSING THE SIDES OF DEEP SLITS ON THE INTRINSIC INTENSITY OF LIGHT TRANSMITTED THROUGH THE SLITS

CLARENCE R. SMITH

It is shown that differences in intensity of the light transmitted by a narrow, deep slit are produced by changing the material of the sides though other conditions are kept constant. With a pair of optically plane surfaces of each of the metals, steel, nickel, gold, silver and copper, a slit was prepared which could be varied in width while the depth remained constant. For each of these metals a curve was prepared showing the variation of transmitted light intensity with change in width of slit. Comparison of the curves for the various metals shows a fairly close agreement for small and for large openings of the slit while considerable differences occur in an intermediate region.

MEASUREMENT OF THE ACOUSTIC IMPEDANCE OF A BRANCH LINE

G. W. STEWART

Acoustic measurement is in its infancy and that of acoustic impedance is peculiarly difficult. A theory of a new method of the measurement of acoustic impedance is presented herewith. How useful it may become must be determined through experience.

Assume an acoustic transmission line with a branch, the latter being of any shape whatever and both line and branch containing a fluid medium. Let the following nomenclature be used:

- ρ is the density of the fluid,
- a is the velocity of sound,
- s is the area of the transmission conduit,
- Z is the acoustic point impedance of the branch.

Two definitions of Z will be used. In the first instance assume Z to be the complex ratio between the pressure at the junction of the branch and the rate of volume displacement of the fluid into it. Let it be represented by $Z_1 + iZ_2$ where Z_1 and Z_2 are real. Then if the apparatus is arranged so that the branch has no influences on the source of sound, the ratio of the transmitted to incident energy can be shown to be

$$(1) \quad \frac{\left[Z_1 \left(Z_1 + \frac{\rho a}{2s} \right) + Z_2^2 \right]^2 + \left(\frac{\rho a}{2s} Z_2 \right)^2}{\left[\left(Z_1 + \frac{\rho a}{2s} \right)^2 + Z_2^2 \right]^2}$$

If, however, Z^4 be defined as the ratio between the pressure and the rate of volume displacement in the branch, the ratio of incident to transmitted energy can be shown to be

$$(2) \quad \frac{\left[Z_1 - \frac{\rho a}{2s} \right]^2 + Z_2^2}{Z_1^2 + Z_2^2}$$

Consider a general case where the attached vessel has a point impedance, Z_a , this referring to a point just *within* the vessel. Denoting this by Z_a , the incident pressure P at the opening can be expressed as:

$$(3) \quad \frac{\rho}{c} \ddot{X} + \frac{\rho a}{2s} \dot{X} + Z_a X = P$$

From this it can be shown that the ratio of transmitted to incident energy is

$$(4) \quad \frac{Z_{a1}^2 + \left[\frac{k a \rho}{c} Z_{a2} \right]^2}{\left[Z_a + \frac{\rho a}{2s} \right]^2 + \left[\frac{k a \rho}{c} + Z_{a2} \right]^2}$$

wherein k is 2π -wavelength and c is the conductivity of the orifice. This is a general formula and has been tested in the case of a cylindrical resonator, a Helmholtz resonator and a simple orifice. In any branch in general, let there be two unknown quantities Z_1 and Z_2 . It is possible to measure the ratio in (4) with conduits of various areas s and thus to obtain the values of Z_1 and Z_2 separately assuming that c is known.

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THE ACTION OF A HELMHOLTZ RESONATOR IN A BRANCH LINE

G. W. STEWART

The general impression of a Helmholtz resonator is that, since its dissipation is small, its tuning is fairly sharp. It is noted with some surprise, therefore, that when used as a side branch in an acoustic transmission line it affects the transmission over a wide range of frequencies. The theory, derived from the general case in the preceding abstract has been checked by experiment with resonators of varying dimensions and the theory verified to a very satisfactory degree.

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